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The Tide is Nigh: Rethinking Urban Flood Management

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Urban flooding is a natural disaster common to all states.[1] Flooding in coastal cities is a particular problem because of the increasing populations and extreme storm activity that can occur in those areas. Two coastal cities in particular—New Orleans,

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1 A 1998 study showed that the ten states with the greatest amount of federal insurance payouts for repeated property losses due to flooding during the period between 1978 and 1995 were spread across the United States. Those states were: Louisiana, Texas, Missouri, New Jersey, Mississippi, Illinois, California, New York, Oklahoma, and Pennsylvania. NATIONAL WILDLIFE FEDERATION, HIGHER GROUND: A REPORT ON VOLUNTARY PROPERTY BUYOUTS IN THE NATION'S FLOODPLAINS 78 (1998) [hereinafter HIGHER GROUND].

Louisiana and Houston, Texas—rank high on the list of cities that have frequent flooding.[2] Indeed, during the last five years, both cities suffered their greatest floods to date.[3] In 2001, the City of Houston weathered a five-day storm that flooded the downtown area which caused over five billion dollars in damage and took the lives of twenty-two people in Harris County alone.[4] The damage to New Orleans from Hurricane Katrina in 2005 was even worse.[5] Breaches in the protective levees surrounding the city resulted in flooding of nearly eighty percent of the city, with the loss of over 1,300 lives and damages estimated at over seventy-five billion dollars.[6]

Gulf Coast flooding is not the only problem. Flooding on the east and west coasts is very common. Northern California and Nevada rang in 2006 with severe flooding caused by five days of rainfall, resulting in mudslides, flooding, evacuations, and power outages.[7] In 2005, New Jersey, New York and Pennsylvania suf-

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2 *Cf. id.* at 145 (noting that New Orleans and Houston are the two cities with the greatest repeated flooding losses from 1978 to 1995).

3 Flood Safety, June 6, 2001 Tropical Storm Allison, http://floodsafety.com/texas/documentaries/j2001/ (last visited Feb. 27, 2006).

4 For five days in June 2001, Houston and other parts of Harris County suffered the effects of one of the most severe storms in United States history. Although never reaching hurricane force, Tropical Storm Allison hit Harris County twice, raining in some areas up to ten inches in her first pass and flooding more than eight hundred homes. On her return, Allison poured another twenty-eight inches on the already saturated ground, resulting in flooding to thousands of homes, the downtown area, and the Medical Center. Harris County was declared a disaster area by both Governor Perry and President Bush, as thousands of people were rescued from their homes and stranded cars. Tropical Storm Allison Recovery Project, TSA Overview: What Was Tropical Storm Allison?, http://www.tsarp.org/tsa_over/index.html (last visited Feb. 27, 2006). Twenty-two people in the Harris County area and nineteen others along Allison's storm path lost their lives in the storm. The storm caused over five billion dollars in damages to Harris County alone. Allan Turner, *Houston Meteorologist Helps Residents Keep Safe, Calm During Bad Weather*, HOUSTON CHRONICLE, May 18, 2003.

5 Hurricane Katrina was the capstone hurricane of a record-breaking season. The 2005 hurricane season was not only the busiest one on record with twenty-six named storms, but it also broke records for the most hurricanes in a season, the greatest number of major hurricanes (including three reaching category five status), and the most hurricanes making landfall. Robert Roy Britt, *Record Hurricane Season Goes Out with a Bang*, LIVESCIENCE, Nov. 25, 2005, http://www.livescience.com/forcesofnature/051129_hurricane_wrap.html. During the six month season in 2005, there were thirteen hurricanes, seven of which were category three or higher, and four of which made landfall. This was also the first season that the Hurricane Center ran out of names on its regular list and switched to the Greek alphabet for naming storms. *Id.*

6 *See* Matthew L. Wald, *Engineers Say a Key Levee Won't be Set For Months*, N.Y. TIMES, SEPT. 14, 2005, at A22; Eliott C. McLaughlin, No More Hurricane Katrinas, CNN.COM, Apr. 7, 2006, http://www.cnn.com/2006/WEATHER/04/06/hurricane.names/index.html; *see also* Janet McConnaughey, *Hurricane Katrina: Storm Toll Misses Some Deaths*, MIAMI HERALD, Dec. 12, 2005, at A10 (stating that the many deaths that occurred due to evacuation from New Orleans have not been counted in the death toll). Hurricane Katrina, which hit Florida and the central Gulf Coast in August, ranks as one of the costliest and most destructive hurricane in U.S. history. McLaughlin, *supra* note 6.

7 Wendy Schultz, *Storms Rock California, Leave Mark on County*, MOUNTAIN DEMOCRAT (Placerville, Ca.), Jan. 4, 2006, at A-1; Justin M. Norton, *Storm Brings Flood-*

fered flooding that required evacuation of thousands of people and caused significant property damage.[8] Similarly, Florida was hit with two major hurricanes during 2005—Wilma and Dennis—that resulted in billions of dollars in damages and over forty dead.[9]

The damage to coastal cities from flooding is far greater than in the past because of increased development along the coastline.[10] Although 2005's hurricane season seemed abnormal, it only seemed so because of a natural lull in storm activity over the last thirty-five years.[11] However, it has been speculated that the increased severity in storm patterns will continue as part of the normal storm cycle for perhaps at least another decade,[12] resulting in far more destruction and flooding as more people move to coastal cities and towns. Indeed, data suggests that by 2010, half of the United States population will live in coastal areas.[13]

This year alone, insurance and reinsurance losses for just three of the major hurricanes this year (Katrina, Rita, and Wilma) were estimated at $57.6 billion dollars, an amount more

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ing and Mud Slides to California and Blizzard to Rockies, PLAIN DEALER (Cleveland, Oh.), Jan. 2, 2006**,** at A1. The problems created by the rains resulted in the governors of both California and Nevada calling states of emergency for many of the affected counties. KRON 4, *Nevada Governor Declares Flooding Emergencies; List Grows in California*, http://www.kron4.com/Global/story.asp?S=4314188&nav=5D7l (last visited Feb. 15, 2006).

8 *See* Associated Press, *East Coast Flooding Spurs Evacuations*, ST. PETERSBURG TIMES, Apr. 5, 2005, at 2A.

9 John Pain*, Frenetic Hurricane Season Ends: Many Records Shattered in '05, and Next Year Might be Bad, Too*, JOURNAL-GAZETTE (Fort Wayne, In.), Nov. 30, 2005, at A10 (noting that Hurricane Dennis caused insured damage of $1.1 billion and fourteen deaths, and Hurricane Wilma caused $6.1 billion in insured damage and thirty-five deaths).

10 As stated, flooding is a nationwide problem and the Midwest has suffered as greatly as coastal areas. For example, the Midwest was troubled with flooding along the Mississippi in 1993 when floodwaters covered more than fifteen million acres of land in nine states and required the evacuation of 54,000 people. Damages from the flood were estimated at fifteen to twenty billion dollars. *See* Scott Siff & David Mears, *The Mississippi River Basin: A National Treasure, A National Challenge*, 12 TUL**.** ENVTL. L.J. 293, 297 (1999).

11 John-Thor Dahlburg, *This Storm Cycle Just Getting Warmed Up*, LOS ANGELES TIMES, Dec. 1, 2005*,* at A18 ("An examination of the last 125 years of hurricane activity along the East and Gulf coasts of the United States shows that tropical cyclone frequency ebbs and flows in 20- to 30- year cycles connected to rising and falling water temperatures in the western Atlantic.").

12 *See* Ann O'Neill, *It's a 'New Era' of Hurricanes*, Sept. 23, 2005, http://www.cnn.com/2005/TECH/science/09/23/hurricane.cycle/index.html. Heightened activity may also be due to global warming and warmer seas. *See* Britt, *supra* note 5.

13 *See* EPA, Nonpoint Source Control Branch, EPA 841-F-96-004G, MANAGING URBAN RUNOFF*, available* at http://www.epa/gov/owow/nps/facts/point7.htm (last visited Feb. 20, 2006) [hereinafter EPA, MANAGING URBAN RUNOFF]; *see also* Martin M. Randall, *Coastal Development Run Amuck: A Policy of Retreat May Be the Only Hope*, 18 J. ENVTL. L. & LITIG. 145, 145 (2003) ("At the end of the twentieth century, more than fifty-three percent of the U.S. population lived in coastal areas comprising only seventeen percent of the nation's land. . . . The population of coastal areas increases by more than 3,600 people each day, and every year more than 800,000 new housing units are constructed.") (footnotes omitted).

than double the annual total for other natural disasters in the United States and one and a half times more than the 2001 terrorist attacks.[14] Depending on the success of flood damage claims and hurricane-related pollution lawsuits, that estimate may be even higher.[15] In light of the tremendous losses suffered this year alone, insurers are seeking alternatives for insuring catastrophes because of ineffective insurance and federal emergency aid.[16] One proposal is a national catastrophe insurance program,[17] an idea that the Florida legislature strongly supports.[18]

Insurance solutions alone, however, are not the answer. In fact, many claim that the National Flood Insurance Program (NFIP) is at least partly responsible for increased flood losses because it has, despite its intent, encouraged greater development in floodplains.[19] To decrease losses, greater measures must be taken to strengthen protection against damage losses. Considering the influx of population to coastal communities, and the concomitant growth in development, it is time to review and revise programs related to flood management and control, to prevent the creation of further problems and become more active in controlling floodplain activity. In particular, care must be taken to guide development in order to prevent the increase of flood risks. In this article, I suggest that this development must follow wiser models of development, incorporating techniques that allow for more effective means of flood management. To do so requires

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14 Reuters, *Hurricane Insurance Losses $57.6 Bln: Advisen*, (Dec. 27, 2005), http://today.reuters.com/business/newsArticle.aspx?type=bankingfinancial&storyID=nN27325901. (noting that Advisen projects pre-tax insured losses to be $40.4 billion for Hurricane Katrina, $6.4 billion for Hurricane Rita, and $10.8 billion for Hurricane Wilma). Flood losses generally reach only six billion dollars annually. *See infra* text accompanying note 38.

15 Reuters, *supra* note 14.

16 Eileen Alt Powell, *Nation Grapples with Insuring Huge Catastrophes*, CHARLESTON GAZETTE, Nov. 18, 2005, at 2D.

17 Insurance commissioners from Florida, California, Illinois and New York held a summit in November 2005 to devise a national catastrophe insurance plan. Ernie Csiszar, president and chief executive of the Property Casualty Insurers Association of America trade group has suggested insurance industry alternatives should issue catastrophe bonds or possibly create private catastrophe pools in preparation for a large disaster, but such alternatives would be difficult because they would require a change in tax and accounting rules. At a government level, he suggests state catastrophe funds backed with a federal fund. Press Release, California Department of Insurance, Insurance Regulators to Launch San Francisco Summit Aimed at Developing a National Catastrophe Insurance Program (Nov. 14, 2005), *available at* http://www.insurance.ca.gov/0400-news/0100-press-releases/0080-2005/release-104-05.cfm; *see* Powell, *supra* note 16, at 2D.

18 In December 2005, the Florida Legislature issued a House Memorial to President Bush and the United States Congress urging the creation of a plan for national catastrophe insurance. *See* H.R. OF FLA., A MEMORIAL TO THE CONGRESS OF THE UNITED STATES URGING CONGRESS TO SUPPORT A NATIONAL CATASTROPHE INSURANCE PROGRAM, H.M. 541-00, at 2 (2006).

19 H. STERLING BURNETT, NAT'L CTR. FOR POL'Y ANALYSIS, PROTECTING THE ENVIRONMENT THROUGH THE OWNERSHIP SOCIETY—PART ONE 13 (Jan. 2006), *available at* http://www.ncpa.org/pub/st/st282/st282.pdf.

close coordination between the jurisdictional bodies that regulate development and the entities empowered with oversight over and authority for funding flood control projects.

Part I of this article begins by discussing the impacts of urbanization and the need for stormwater and flood management. It explains that development has led to the increase in impervious cover, which increases the volume of water that can create flood conditions and decreases water quality because of the contaminants that urban runoff carries. Part II then turns to an analysis of the NFIP, which is the basis for our current flood management policy. It discusses the evolution of the program from its inception, and the legislative changes that have been required as failures in the system have developed. Part II also discusses how the insurance program served as the catalyst for the creation of local flood management policies and how the program has failed to fully realize its potential. Part III suggests that greater local efforts are required to create a more effective flood management system. The article concludes with recommendations for improvement, such as taking a more active role in risk assessment, implementing and maintaining appropriate flood technology that is more ecologically friendly, becoming more aggressive in acquiring repetitive loss properties in flood-prone areas, and establishing wiser patterns of development through the enactment of more stringent floodplain ordinances, the use of Smart Growth initiatives, and the encouragement of low impact development.

I. URBANIZATION AND FLOOD MANAGEMENT

Increased urbanization has led to greater amounts of urban runoff,[20] and the loss of floodplains to development has increased the flood losses that can occur as flood waters continue to take their normal course, flooding whatever is in the way. Destruction of floodplains not only reduces filtering abilities, but also diminishes other values of the floodplain as well. As one report put it:

> Serving their natural functions, floodplains are vast absorptive reservoirs of floodwaters; they are the Earth's primary filter and dissolver of waterborne contaminants; their coastal marshes and riverine wet-

20 Urban runoff is the mixture of rainwater or snowmelt and the contaminants it picks up as it crosses impervious surfaces in urban areas. *See* EPA, OFFICE OF RESEARCH AND DEVELOPMENT, EPA-625-R-93-004, HANDBOOK: URBAN RUNOFF POLLUTION PREVENTION AND CONTROL PLANNING 2 (1993), *available at* http://www.epa.gov/ORD/NRMRL/pubs/625r93004/625r93004.pdf [hereinafter EPA, URBAN RUNOFF POLLUTION]; Avi Brisman, *Considerations in Establishing a Stormwater Utility*, 26 S. ILL. U. L.J. 505, 505–06 (2002); Joel B. Eisen, *Toward a Sustainable Urbanism: Lessons from Federal Regulation of Urban Stormwater Runoff*, 48 WASH. U. J. URB. & CONTEMP. L. 1, 12 (1995).

> lands provide the creative essentials for countless forms of life; and left to themselves, floodplains and the life they generate offer enjoyment and recreation.[21]

The damage that can result from both urban runoff and floodplain loss is great.

A. Urban Runoff

As more land is reduced to impervious cover,[22] the drainage benefits that occur naturally from land are lessened. Rather than percolating into the ground, water is channeled away from its normal course along paved roads, parking lots, roofs and storm sewers, picking up contaminants along the way. These contaminants eventually result in lower water quality as runoff reaches the various receiving water bodies.[23]

The problems of urban runoff are several. First, impervious cover and the use of sewer systems increase the volume of water and pollutants because the water fails to evaporate or absorb into the soil before reaching a receiving body.[24] Therefore, the volume and velocity of water and the pollutants channeled into water bodies are greater, resulting in an increased risk of stream bank erosion, vegetation damage and stream channel alteration.[25] This, in turn, leads to changes in the normal water level between and during storm events, greater sediment content in the water body, and higher water temperatures, all of which can impact fish and other aquatic life.[26]

Second, the pollution that results from urban runoff is more severe than pollution resulting from non-urban runoff because

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21 HIGHER GROUND, *supra* note 1, at 11.

22 The amount of impervious cover in a given area depends on its use. Commercial areas may be up to 90% impervious cover. *See* Marc A. Yaggi, *Impervious Surfaces in the New York City Watershed*, 12 FORDHAM ENVTL. L.J. 489, 499–500 (2001) (noting that coverage in residential areas may range from 25% to 60%, industrial areas may range from 60% to 70%, and commercial areas may range from 80% to 90% (citing GEODIGITAL MAPPING, INC., SIGNIFICANT SOURCES OF URBAN STORM WATER RUNOFF IN UNINCORPORATED AREAS OF THE SOUTH COAST OF SANTA BARBARA COUNTY IDENTIFIED FROM LANDSAT IMAGERY: REPORT TO THE SANTA BARBARA COUNTY WATER AGENCY 2 (2000))).

23 *See id.* at 496 n.43.

24 *See* Brisman, *supra* note 20, at 509–11.

25 *See id.* at 509 (noting the direct correlation between the volume and velocity of runoff and the amount of impervious cover in a given area). *See also id.* at 509 n.20 ("On a 1-acre natural meadow, a 1-inch rainstorm normally produces 218 cubic feet of runoff. The same 1-inch storm on a 1-acre paved parking lot would produce 3,450 cubic feet of runoff approximately sixteen times more than the natural meadow.") (citing PETER H. LEHNER ET AL., STORMWATER STRATEGIES: COMMUNITY RESPONSES TO RUNOFF POLLUTION 30 (1999)); Yaggi, *supra* note 22, at 499 (stating that after development, runoff in residential areas can be up to ten times higher than pre-development conditions and up to eighteen times higher in commercial areas).

26 EPA, MANAGING URBAN RUNOFF, *supra* note 13.

the pollutants found in urbanized areas are more diverse and numerous than those found in undeveloped areas.[27] Construction sites, landfills, septic systems, storage tanks, pesticides, herbicides, and petroleum spills all contribute to the contamination of ground and surface water.[28] In many older sewer systems, stormwater may reach the receiving water untreated, increasing the potential for pollution.[29] Urban runoff, contaminated as it often is, can have significant impacts on water quality, threatening aquatic life and habitat, human drinking water and food supplies.[30]

B. Flooding

Flooding in urban areas exacerbates the environmental and health risks associated with urban runoff. Unlike during a normal rain event, heavy storm precipitation or storm surge is landbound for a longer period because of the greater amounts of water at issue, creating water hazards and health risks.[31] Flooding also creates the risk of contamination of drinking water supplies[32] and the development of mold contamination in flooded structures.[33] Indeed, according to the Centers for Disease Control and Prevention, massive mold contamination is an expected result from both Hurricanes Katrina and Rita because many structures remained flooded for weeks after the hurricanes.[34] Further, flash floods can cause extreme damage, physical injury

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27 Contaminants often found in urban runoff include sediments, nutrients, pathogens, organic enrichment pollutants (e.g., biochemical oxygen demand and dissolved oxygen), trace amounts of toxic metals, organics, salts, and even airborne pollutants from automobile and industrial emissions. EPA, URBAN RUNOFF POLLUTION, *supra* note 20, at 5**,** tbl.1-2; Eisen, *supra* note 20, at 14–15; Brisman, *supra* note 20, at 505–06.

28 *See* EPA, URBAN RUNOFF POLLUTION, *supra* note 20, at 5, tbl.1-2; Brisman, *supra* note 20, at 510–11.

29 EPA, MANAGING URBAN RUNOFF, *supra* note 13.

30 EPA**,** URBAN RUNOFF POLLUTION, *supra* note 20, at 5, tbl.1-2; Brisman, *supra* note 20, at 505–06, 512–14; Eisen, *supra* note 20, at 18–19; Yaggi**,** *supra* note 22, at 497–98.

31 *See, e.g.*, World Health Organization, *Flooding and Communicable Diseases Fact Sheet,* http://www.who.int/hac/techguidance/ems/flood_cds/en/ (last visited Feb. 20, 2006) [hereinafter World Health Organization] (noting that health risks may include waterborne diseases, vector-borne diseases, drowning, as well as risks posed by corpses). *But see* U.S. Department of Health & Human Services, Centers for Disease Control and Prevention, *After a Hurricane: Key Facts About Infectious Disease*, http://www.bt.cdc.gov/disasters/hurricanes/keyfactsinfectiousdisease.asp (last visited Feb. 20, 2006) (noting that widespread outbreak of infectious disease is uncommon in the United States after hurricanes).

32 *See* World Health Organization, *supra* note 31.

33 *See* CENTERS FOR DISEASE CONTROL AND PREVENTION, THE CDC MOLD WORK GROUP, MOLD: PREVENTION STRATEGIES AND POSSIBLE HEALTH EFFECTS IN THE AFTERMATH OF HURRICANES KATRINA AND RITA iv, 1-2 (Oct. 2005), *available at* http://www.bt.cdc.gov/disasters/mold/report/.

34 *Id.* at iv (noting that "as many as 60% to 80% of residential structures in New Orleans sustained severe flood damage").

and loss of life.[35] Flash floods result when an area is subject to severe or multiple thunderstorms. Because the ground becomes saturated quickly, rainwater flows rapidly toward receiving water bodies, creating water hazards along the way. Most flood-related deaths are due to flash floods, mainly because people underestimate the water's power.[36]

As seen frequently in the news, the aftermath of flooding can be devastating. Losses in human life, property damage, and disruption to the lives and livelihood of those affected are only part of the story. One must also factor in other losses as well—loss of livestock, wildlife and habitat, the funds spent on disaster relief, the impact on insurance costs, as well as the psychological impact on flood and evacuation victims. Analyses show that flood losses have been steadily increasing, with last year's losses topping the charts.[37] Before that, however, flood losses had been estimated at approximately six billion dollars annually, a three-fold increase from flood losses in the early part of the twentieth century.[38]

Increased urbanization plays a large role in these larger losses because of the greater numbers of people who can suffer flood losses and because of the deleterious effects caused by the development needed to house the increased population. However, other factors play a role as well. Changes in climatic conditions have had a greater impact on flooding losses as the hurricane season has become more active.[39] Misplaced reliance on flood technology unsuitable for urban needs and continued development in at-risk, flood-prone areas also have increased losses.[40] Even the federal government has played a role by creating an "entitlement mentality" with disaster aid and by subsidizing reconstruction through the NFIP, thereby enabling repeated flood

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35 Flash floods are the second greatest cause of hazard-related deaths, with the first being heat-related injuries. *See* National Weather Service, Southern Region Headquarters, *Turn Around Don't Drown*, http://www.srh.noaa.gov/srh/tadd/ (last visited Feb. 20, 2006).

36 National Weather Service, *supra* note 35.

37 National Weather Service Hydrologic Information Center, *Flood Losses: Compilation of Flood Loss Statistics*, http://www.nws.noaa.gov/oh/hic/flood_stats/Flood_loss_time_series.shtml (last visited Feb. 20, 2006); Insurance Journal, *2005 Hurricane Losses to Top $57 Billion, Advisen Reports*, Dec. 27, 2005, http://www.insurancejournal.com/news/national/2005/12/27/63514.htm (noting that 2005 hurricanes constituted the largest "cumulative catastrophe losses . . . on record").

38 Larry Larson & Doug Plasencia, *No Adverse Impact: A New Direction in Floodplain Management Policy*, NATURAL HAZARDS REVIEW, Nov. 2001, at 168 (estimating annual flooding losses during the early 1900's at $2.2 billion).

39 *See* Dahlburg, *supra* note 11, at A18; O'Neill, *supra* note 12; *see also* Larson & Plasencia, *supra* note 38, at 168 ("It has been suggested that we are having more frequent and more severe flooding due to climatic variation.").

40 *See* Larson & Plasencia, *supra* note 38, at 168.

losses.[41] Each of these factors calls for changes in our current flood management programs.

II. NATIONAL FLOOD INSURANCE PROGRAM

Prior to the late 1960's, the U.S. Army Corps of Engineers managed most flood control projects.[42] As these flood-control works were out-paced by floodplain development, Congress sought other solutions, eventually settling on the NFIP.[43] Because of failures in the system, however, the NFIP has arguably served as a subsidy to high-risk growth in the floodplain, creating the need for more stringent floodplain management. To fully appreciate how local governments can improve flood management, it is important to understand how the federal program operates because it was this program that served as the catalyst for local floodplain management.

A. Enactment of the NFIP

The NFIP was established under the Federal Emergency Management Agency (FEMA) in 1968[44] to respond to the increasing damages caused by floods. The program's goal is not only compensation, but also prevention by only allowing participation in the program by those communities willing to enact floodplain management ordinances that minimize the risk of floods created by new construction.[45] Effectively, Congress sought to insure those who were most at risk of flooding, but only if incentives were created to discourage others from adding to the problem.

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41 *See* HIGHER GROUND, *supra* note 1, at 6 ("The availability of federally sponsored flood insurance and the expectation of an entitlement to government relief if disaster occurs encourages floodplain development and repeated rebuilding in high-risk areas each time catastrophe strikes."); Larson & Plasencia, *supra* note 38, at 170–71 (arguing that federal aid leads local governments to believe that flood management is a federal issue).

42 For an excellent discussion of the federal approach to flood management prior to the NFIP and the events leading up to adoption of the program, *see* Oliver A. Houck, *Rising Water: The National Flood Insurance Program and Louisiana*, 60 TUL. L. REV. 61, 64–72 (1985).

43 42 U.S.C.A §§ 4001–4129 (2003). The National Flood Insurance Program is administered by the Federal Insurance Administration, which is a part of FEMA. FEMA, MANDATORY PURCHASE OF FLOOD INSURANCE GUIDELINES-LEGAL REFERENCES 1-1 (Sept. 1999), http://www.fema.gov/pdf/nfip/mpapp1.pdf [hereinafter FEMA-LEGAL REFERENCES]. Prior to March 2003, FEMA was an independent agency. However, enactment of the Homeland Security Act of 2002 transferred FEMA to the Emergency Preparedness and Response Directorate in the Department of Homeland Security. *See* Homeland Security Act of 2002, Pub. L. No. 107-296, 116 Stat. 2135 (codified in 6 U.S.C.S. §§ 101–557); *see also* FEMA, About FEMA-FEMA History, http://www.fema.gov/about/history.shtm (last visited Feb. 21, 2006).

44 *See* FEMA-LEGAL REFERENCES, *supra* note 43, at 1-1 to 1-2.

45 John G. Culhane, *Tort, Compensation, and Two Kinds of Justice*, 55 RUTGERS L. REV. 1027, 1104 (2003) (noting that the NFIP is funded by premiums paid by owners of insured structures).

The initial response to the NFIP was underwhelming. In 1972, there were fewer than 100,000 policyholders and less than 1,200 communities participating in the program.[46] To compel participation, Congress enacted the Flood Disaster Protection Act of 1973 (FDPA),[47] which made the availability of federal assistance for construction in flood hazard areas contingent on an individual's purchase of flood insurance.[48] Unsurprisingly, community response improved as insurance became unavailable to communities that were not a part of the NFIP. By 1974, NFIP participation had increased to almost 6,000 communities; by 1978, to 16,000.[49] Now, more than 22,000 communities participate in the program.[50]

Although community participation in the NFIP became much more common after enactment of the FDPA, individual homeowner participation decreased as lenders became less vigilant in policing the program's requirements.[51] After flooding in the Midwest revealed substantial problems with the program,[52] Congress enacted the National Flood Insurance Reform Act of 1994,[53] which fines lenders up to $100,000 per year for failing either to identify structures located in special flood hazard areas or to require flood insurance for such structures.[54]

Congress enacted the Flood Insurance Reform Act of 2004[55]

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46 Houck, *supra* note 42, at 70.

47 Flood Disaster Protection Act of 1973, Pub. L. No. 93-234, 87 Stat. 975 (codified in 42 U.S.C. 4001 *et seq.*); FEMA-LEGAL REFERENCES, *supra* note 43, at 1–2.

48 Houck, *supra* note 42, at 70–71 (citing Flood Disaster Protection Act § 102). A 1977 amendment to the Flood Disaster Protection Act resulted in a partial lifting of the ban on federal assistance to non participating communities in response to vocal developers. However, as Professor Houck explains, the amendment weakened the NFIP and guaranteed money for floodplain development in exactly the way that the Flood Disaster Protection Act was not intended to be used. *Id.* at 72 & n.57 (stating that "[d]evelopers argued that they should not be precluded from assistance in developing the floodplains as long as they assumed the risk of subsequent flooding," but noting that "it is not the developers who bear the subsequent flood losses but rather the purchasers of these new homes or businesses").

49 *Id.* at 71; *see also* Randall, *supra* note 13, at 150 (noting that policy holders under the NFIP increased from 300,000 to 1.2 million in the first four years after enactment of the Flood Disaster Protection Act).

50 Culhane, *supra* note 45, at 1104.

51 Randall, *supra* note 13, at 150.

52 Steven E. Ehlmann, *Conflict at the Confluence: The Struggle Over Federal Flood Plain Management*, 74 N.D. L. REV. 61, 68–69 (1998).

53 National Flood Insurance Reform Act of 1994, Pub. L. No. 103-325, 108 Stat. 2255 (codified as amendments in scattered sections of 42 U.S.C. §§ 4001–4129).

54 Randall, *supra* note 13, at 150–51 (citing National Flood Insurance Reform Act § 521, 525). A lender's obligation extends past the creation date of the loan as well. Even if a structure was not located in a special flood hazard area when a loan was created, if a flood map is updated during the loan's lifetime and the structure falls within the area, the lender is obligated to require the borrower to obtain flood insurance. If the borrower fails to do so, the lender must obtain insurance on the borrower's behalf and charge it to the borrower. *Id.* (citing National Flood Insurance Reform Act § 524).

55 Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004, Pub. L. No.

to deal with additional issues. First, it re-authorized the NFIP through 2008, rather than requiring yearly re-evaluation, to ensure continuous coverage for at least another five years.[56] Second, it provided appropriations for a pilot program to purchase "repetitive loss" properties, which cause a significant drain on the NFIP.[57] If an owner refuses an offer of mitigation assistance, the owner's insurance premiums will increase to 150% of the chargeable rate for the property at the time of the offer, with an additional 150% increase for each future claim over $1,500, limited only by premium insurance rates as a cap.[58]

Presidential support for floodplain management has also been strong. In addition to the carrot-and-stick approach used by the NFIP for local management, floodplain management was given a boost with two executive orders. The first, Executive Order 11,988, was signed by President Carter in 1977.[59] Under this order, federal agencies are ordered to "provide leadership and . . . take action to reduce the risk of flood loss, to minimize the impact of floods on human safety[,] health and welfare, and to restore and preserve the natural and beneficial values served by floodplains in carrying out [the agency's] responsibilities . . . ."[60] To implement the Order, agencies are required to establish procedures for considering the impact that their actions might have on floodplains and to establish construction standards for federal projects consistent with the NFIP standards.[61] During the same year, Executive Order 11,990 was signed, which ordered agencies to "take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities . . . ."[62] This Order included, as one of the considerations for determining whether wetlands would be disturbed by a federal project, the functions that the wetlands performed, including those relating to flood and storm hazards.[63] Thus, under these orders, federal agencies are required to do their part to reduce

108-264, 118 Stat. 712 (codified in scattered sections of 42 U.S.C.).

56 *See id.* § 101.

57 The program covers severe repetitive loss properties, which are defined as those "for which 4 or more separate claims payments have been made . . . each such claim exceeding $5,000, and with the cumulative amount of such claims payments exceeding $20,000 . . . ." *Id.* § 102(a).

58 *See id.* § 102(a).

59 Exec. Order 11,988, 42 Fed. Reg. 26,951 (May 24, 1977), *amended by* Exec. Order 12,148, 44 Fed. Reg. 43,239 (July 20, 1979).

60 *Id.* § 1, 42 Fed. Reg. at 26,951.

61 *Id.* §§ 1–3, 42 Fed. Reg. at 26,951. The Executive Order urged use of existing mechanisms, such as regulations under the National Environmental Policy Act, for compliance with the order. *See id.* § 2(d), 42 Fed. Reg. at 26,951.

62 Exec. Order 11,990, 42 Fed. Reg. 26961 (May 25, 1977), *amended by* Exec. Order 12,608, 52 Fed. Reg. 34,617 (Sept. 9, 1987).

63 *See id.* § 5(a), 52 Fed. Reg. at 34,617.

flood losses.

B. Community Requirements

The greater burden of floodplain management falls on local communities. Prior to the NFIP, local communities made little effort at floodplain protection. However, ***c***reation of the NFIP and subsequent amendments to the program have encouraged floodplain management because federal loans were linked to the requirement to purchase subsidized insurance.[64] This required communities to participate in the program to ensure the availability of federal funds to the communities' citizenry. To participate in the NFIP, interested communities must adopt "adequate land use and control measures" that will

> to the maximum extent feasible . . . (1) constrict the development of land which is exposed to flood damage where appropriate, (2) guide the development of proposed construction away from locations which are threatened by flood hazards, (3) assist in reducing damage caused by floods, and (4) otherwise improve the long-range land management and use of flood-prone areas.[65]

Community standards must, at a minimum, meet federal standards set out in FEMA guidelines.[66] A particular community's minimum obligation depends on the type of flood risk presented by the community as determined by FEMA, which uses a 100-year flood as its risk standard.[67] To determine community flood risks, maps are developed that identify the 100-year floodplain, the base flood elevation and special flood hazard areas.[68] These maps are then used in several ways. Lenders use the information provided to determine flood insurance rates, and communities use the maps to assist in developing floodplain management ordinances.[69] The maps are also used by community planners, local officials, and even builders and developers in making other land use decisions.[70]

FEMA standards for floodplain management require that

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64 *See* FEMA, Federal Insurance and Mitigation Administration, National Flood Insurance Program: Program Description 3–4 (Aug. 1, 2002), *available at* http://www.fema.gov/doc/library/nfipdescrip.doc [hereinafter FEMA, NFIP Program Description].

65 42 U.S.C.A. § 4022 (West 2003), 42 U.S.C. § 4102(c) (2000).

66 *See* 44 C.F.R. § 60.3 (2004).

67 FEMA, NFIP Program Description, *supra* note 64, at 5, 13.

68 The 100-year floodplain is the area that will be inundated by water in the event of a 100-year flood (a "base flood"), that is, a flood that has a "one percent chance of being equalled or exceeded in any given year." Base flood elevation is the estimated height that waters will rise in the event of a base flood and is used to calculate the impact that a 100-year flood will have on the property. 44 C.F.R § 59.1 (2004).

69 *See generally* FEMA, NFIP Program Description, *supra* note 64 (explaining how the maps detail various flood zone types, the construction materials necessary to withstand flood forces, and the likelihood of flooding certain areas, among other things).

70 *See id.* at 5–18.

development in special flood hazard areas be properly permitted and reviewed by the community for consistency with its ordinance.[71] Subdivision or other new development proposals require review to determine that the development will be reasonably safe from flooding and that utilities are constructed to minimize flood damage.[72] The NFIP also requires communities to enact local floodplain ordinances that restrict certain development in the floodplain.[73] Basically, the NFIP minimum floodplain management standards require that new, improved or substantially damaged construction be raised above the base flood elevation or dry-floodproofed, depending on the type of structure at issue, and constructed with proper materials.[74] Construction is only prohibited in floodways designated by the community if the development would cause an increase in flood heights.[75]

C. Failure of the System

Floodplain development has always been a problem. Indeed, even as the U.S. Army Corps of Engineers sought to construct works to protect people from flood hazards, the floodplains continued to fill, mainly at the expense of the federal government. As Professor Houck explains:

> [t]he construction approach failed for both physical and psychological reasons. A major difficulty was that federal protective works, however generously funded, simply could not keep pace with the rate that development was encroaching upon the floodplain. A United States Senate committee concluded that after thirty years of federal projects the "average annual flood hazard is now greater than before . . . because people have moved themselves and their property into flood-prone areas faster than flood protection works have been built." The economics of these projects encouraged just such development. The local community "[got] most of the benefits of the project and [paid] only part of the costs. . . . To the [individual landowner], the Federal flood protection [was often] a windfall."[76]

Even after initial enactment of the NFIP, floodplain development continued, despite the NFIP's goal to limit floodplain construc-

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71 The community must also ensure that any development in these areas has received all permits required under state or federal law. *See id.*

72 *See id.* at 12–18.

73 *See id.*

74 *See id.* at 13 (indicating that "[d]ry floodproofing means that the building must be designed and constructed to be watertight, substantially impermeable to floodwaters"). Other specific design requirements are imposed depending on the flood zone of the structure's location. *See id.* at 13–14 (identifying standards for A Zones and V Zones).

75 *Id.* at 14. ("The floodway generally includes the river channel and adjacent floodplain areas that often contain forests and wetlands . . . . This requirement has the effect of limiting development in the most hazardous and environmentally sensitive part of the floodplain.").

76 Houck, *supra* note 42, at 66 (footnotes omitted).

tion, because "development was being encouraged by federal agencies and by the availability of federally insured loans, grants, and guarantees for land acquisition and construction in floodplain areas."[77] This construction motivated Congress to shore up the NFIP with the FDPA.

Many now argue that, despite its good intentions, the NFIP serves to subsidize high-risk development in floodplains by providing flood insurance at low cost rather than at true actuarial premiums.[78] FEMA provided low cost insurance for structures existing prior to the creation of flood maps based on the idea that they were "'built by individuals who did not have sufficient knowledge of the flood hazard to make informed decisions'" and because it was "assumed that flooding, attrition, and floodplain management ordinances would eventually result in the elimination of all 'pre-FIRM' [flood insurance rate map] structures from the NFIP portfolio."[79] However, this has not been the case, as many structures have been repeatedly flooded and rebuilt, funded by flood insurance. Indeed, a study by the National Wildlife Federation shows that "[n]early one out of every ten repetitive loss homes . . . have had cumulative flood insurance loss claims that exceed the value of the house — in some cases many times over."[80] One home in Houston, for example, received over $806,000 for sixteen flood events occurring over an eighteen-year period, despite the fact that the home was valued at less than $115,000.[81]

Time and again, as failures in the system are discovered, Congress has sought to fix the problem with legislation. Yet not all the problems lie with the NFIP. More action can, and should, be taken at the local level in floodplain management. Indeed, many jurisdictions take a very active role in this process. However, there are areas for improvement, as addressed in Part III.

III. RECOMMENDATIONS

Effective flood management requires accurate risk assessment, properly maintained flood control technology that is appropriate for the area, and carefully controlled development. Of

77 *Id.* at 70 (citation omitted). Levee construction has also been blamed for the increase in floodplain development because the federal government provided three-to-one matching funds for structural improvements, an option the communities found very desirable. *See* HIGHER GROUND, *supra* note 1, at 7.

78 *See, e.g.*, HIGHER GROUND, *supra* note 1, at 6; Randall, *supra* note 13, at 151–52.

79 Randall, *supra* note 13, at 152 (footnotes omitted).

80 HIGHER GROUND, *supra* note 1.

81 *Id.* Stories such as this one led to enactment of the Insurance Reform Act of 2004. For a discussion of the eighteen properties that suffered eighteen flood events or more, *see id.* at 105–07.

course, one must keep in mind that flood management is merely that—management. Despite the technical controls and improvements that a community might put into place to manage the risks presented by storm events, those controls may be overwhelmed by any particular storm which places too great a burden on them.[82] The goal of effective flood management is to reduce risks to health and property. In most cases, it is impossible to plan for every possible event. However, communities should assist the federal government in reducing the risks of storm events by taking a more active role in floodplain management.

A. Improved Risk Assessment

As discussed above, flood risks, which are established by floodplain mapping, determine regulation and insurance rates. Until FEMA's recent attempts at map modernization, many of its flood maps were out of date. Indeed, according to the United States Government Accountability Office, nearly seventy percent of the nation's 92,222 flood maps were ten years old at the time of its review.[83] Since conditions creating flood hazards are constantly changing, new developments are often not reflected on current maps. Therefore, insurance data is out of sync with actual risk, and attempts at floodplain management are not as effective as they could be.

FEMA has recently sought to modernize its maps and make them more accessible by placing digitized maps on the Internet through its Map Modernization Project.[84] The project is a five-year plan for updating flood hazard data.[85] As part of its modernization effort, FEMA has promoted the use of advanced technology, including the use of geographic information systems and remote sensing technology, such as Light Detection and Ranging (LIDAR).[86] Use of the new technology improves accuracy and re-

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82 *Cf.* Houck, *supra* note 42, at 67 ("Even the best of structures 'can confine floods of limited magnitudes, but every so often a really big one will top it' and, once topped, the levee 'tends to aggravate and prolong inundation beyond what it would have been' without it." (citation omitted).

83 U.S. GOVERNMENT ACCOUNTABILITY OFFICE, GAO 05-894T, FLOOD MAP MODERNIZATION: FEDERAL EMERGENCY MANAGEMENT AGENCY'S IMPLEMENTATION OF A NATIONAL STRATEGY 6 (2005) (statement of William O. Jenkins, Jr., Director of Homeland Security and Justice Issues), *available at* http://www.gao.gov/new.items/d05894t.pdf [hereinafter GAO, FLOOD MAP MODERNIZATION].

84 *Id.* at 3.

85 FEMA, DRAFT FY05-FY09, MULTI-YEAR FLOOD HAZARD IDENTIFICATION PLAN 1:0 INTRODUCTION, 1-1 (June 2005), *available at* http://www.fema.gov/fhm/mh_mhip_ver1_5.shtm.

86 GAO, FLOOD MAP MODERNIZATION, *supra* note 83, at 7. LIDAR is a system that allows collection of far more detailed data than in years past by the use of specially equipped aircraft. The aircraft projects millions of laser signals to the ground, data from which is then collected and converted by software into an image of the terrain and all objects on it, including buildings, streets, and waterways. By using the technology, a com-

duces the costs of traditional survey methods by half.[87]

Although FEMA's map modernization project has promise, the agency must still work out problems in the system. For example, in past mapping efforts, FEMA has used a blanket minimum standard that covered all flood maps and supporting data.[88] To establish mapping priorities and to reduce costs of the modernization project, FEMA instead sought to balance the relative flood risks faced by each community against the effort required to produce reliable flood hazard data by ranking all counties based on several specified factors.[89] However, the standards required for each flood risk category for analysis and data collection have yet to be promulgated, leading to inconsistency within categories and little guidance for those who have partnered with FEMA to prepare the new maps.[90]

In addition, FEMA's map modernization project relies largely on partnering with local, state, and federal partners to assist with funding and data acquisition.[91] To this end, FEMA has asked various states, territories and certain cooperating technical partners[92] to prepare business plans showing mapping need assessments.[93] The partnering entity then obtains the mapping data and provides it to FEMA. However, FEMA does not account for the impact on smaller communities; these localities

munity can more effectively utilize resources, as it creates a better representation of the topography while being more cost effective than traditional survey methods. Once collected, the data can then be combined with data from waterway surveys to create computer simulations of flood risk areas. The maps created from these models can then be used to update FEMA insurance maps. The Harris County Flood Control District, as part of its Tropical Storm Allison Recovery Project, has partnered with FEMA and is currently using LIDAR to re-map the Harris County floodplains. *See* Harris County Flood Control District, Learning Center, LiDAR: What is it?, http://www.hcfcd.org/lidar.asp?flash=yes (last visited Feb. 28, 2006).

87 FEMA, DRAFT FY05-FY09, MULTI-YEAR FLOOD HAZARD IDENTIFICATION PLAN 8:0 COST-SAVING PROCESSES, PROCEDURES, AND TOOLS, 1-1 (Nov. 2004), *available at* http://www.fema.gov/pdf/fhm/mh_ch8.pdf.

88 GAO, FLOOD MAP MODERNIZATION, *supra* note 83, at 10–11.

89 *Id.* at 10 (noting such factors include population, growth trends, housing units, flood insurance policies and claims, repetitive loss properties and flood disasters).

90 *See id.* at 11.

91 *See id.* at 13–14 (noting that "from fiscal years 2000 to 2002, FEMA used $70 million of its federal map modernization funding along with state and local funds to develop what FEMA has estimated to be more than $155 million worth of new mapping data").

92 A cooperating technical partner (known as a "CTP") is a community or regional or state agency that partners with FEMA (after meeting certain eligibility requirements) as part of its Flood Hazard Mapping Program. Such agencies may include flood control or watershed management districts, regional planning councils or councils of government, or even regional offices of state agencies. *See* FEMA, Flood Hazard Mapping, http://www.fema.gov/fhm/ctp_qa1.shtm (last visited Feb. 28, 2006).

93 As of June 2005, fifty-six plans covering forty-nine states had been submitted. *See* FEMA, DRAFT FY05-FY09, MULTI-YEAR FLOOD HAZARD IDENTIFICATION PLAN 2:0 STAKEHOLDER INPUT 2-2 (June 2005), *available at* http://www.fema.gov/pdf/fhm/mh_2ver1_5.pdf.

do not have the means, nor the expertise, to develop the flood hazard data. Therefore, FEMA must come up with adequate strategies to overcome these limitations.[94] Further, the accuracy of the mapping (using LIDAR, for example) is dependent on the quality and experience of the contractor hired to perform the process. Therefore, inconsistency may result in the quality of FEMA maps. Active FEMA oversight is required to ensure the desired outcome of the mapping project.[95]

Local communities can help with more accurate risk assessment by partnering with FEMA to update the flood maps for their areas. Communities with little funds for mapping initiatives can band together with nearby communities or seek state aid to help fund the costs needed for map modernization projects. Creating new and more accessible maps will create several benefits. Community planners, for example, can make more accurate predictions of flood risks and plan accordingly with regard to community development.[96] By the same token, map modernization may lead to increased participation in the NFIP because of a more accurate identification of properties within the floodplain.[97] Further, the maps can be used at national, state, and local levels for risk management purposes for multiple hazards (both natural disasters and terrorist scenarios) because of the precise data regarding the location of vulnerable facilities.[98] Local involvement in the process will help guarantee the success of this program.

B. Improved Flood Control Technology

A major part of flood management lies in choosing the best tools for managing flood risks. In some cases, the best tools involve structural technology that provides protection from urban floodwaters. In other instances, however, non-structural tech-

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94 GAO, FLOOD MAP MODERNIZATION, *supra* note 83, at 14. The Government Accountability Office suggests, for example, partnering with state agencies with mapping needs in that area (e.g., transportation departments). *See id.*

95 *See id.* at 15.

96 *See id.* at 8–9.

97 *See id.* at 9, 12. FEMA's desire for greater community participation is to give the community a feeling of ownership over the maps and the work that went into it. As FEMA explains:

> if a community is involved in and understands the map modernization process, the community is more likely to accept and trust the accuracy of the final, revised maps and is more likely to use the maps' hazard data to mitigate natural and man-made disasters. Conversely, if affected property owners do not understand why their communities are being mapped (or remapped) or why their property is now in a flood zone, the unexpected additional expense of new or increased flood insurance premiums can form the basis of significant community opposition to map modernization activities and lead to formal appeals, litigation, and delays in implementing map changes.

Id. at 12.

98 *Id.* at 9.

nology provides a better solution as it can eliminate losses at less cost and less change to the environment.[99]

1. Structural Technology

Urbanization has led to an increase in stormwater problems and an increased need for management. The traditional approach to stormwater management has been drainage— move the water off the land as quickly and as efficiently as possible.[100] This approach has led to the widespread use of storm sewers and the widening and deepening of existing natural channels (channelization) that drain the water to another water body.[101] The problem with such use, however, is that the water is often untreated;[102] the pollutants that the stormwater may pick up as it runs across the ground are conveyed to the receiving water body, leading to a reduction in water quality. Therefore, treatment systems may be required in extreme situations, which add costs to a management program.[103]

The levee is another less than satisfactory structural form of flood technology. Levees are used to physically protect an area from rising floodwaters and, although effective in some areas, are not always the best solution. First, levees tend to remove land from the floodplain that could otherwise be used for storage of floodwaters.[104] Therefore, it may be difficult to restrain the water to a more measured flow as it moves towards its ultimate destination. Further, because levees are a physical barrier, they may in some instances block the water's movement, thereby cre-

99 *See* N.C. DIV. OF EMERGENCY MGMT., DESIGN AND CONSTR. GUIDELINES: TOOLS AND TECHNIQUES FOR MITIGATING THE EFFECTS OF NATURAL HAZARDS 6–7 (Oct. 1998), *available at* http://www.ncem.org/mitigation/Library/Full_Tools_and_Tech.pdf.

100 EPA, EPA-841-B-00-005, LOW IMPACT DEVELOPMENT (LID): A LITERATURE REVIEW 1 (Oct. 2000), *available at* http://www.epa.gov/owow/nps/lid/lid.pdf [hereinafter EPA, LOW IMPACT DEVELOPMENT].

101 Water flow and capacity can be increased by reducing friction by removing woody vegetation and lining the channel with concrete. Harris County Flood Control District, Flood Damage Reduction Tools, http://www.hcfcd.org/floodtools.html (last visited Feb. 28, 2006) [hereinafter Harris County Flood Control District, Flood Damage Reduction Tools]; *see also* Harris County Flood Control District, *Riding the Waves of Change 60 Years of Service, available at* http://www.hcfcd.org/downloads/brochures/HCFCD_60Year HistoryBrochure.pdf 6 (last visited Mar. 1, 2006) [hereinafter Harris County Flood Control District, *Riding the Waves*].

102 *See* EPA, LOW IMPACT DEVELOPMENT, *supra* note 100, at 12.

103 Physical debris can be collected from receiving bodies after the fact to reduce pollution problems with tools such as trash skimmers. *See generally* LAURA FIFFICK, PORT OF HOUSTON AUTHORITY, MIGHTY TIDY (2003), http://www.aapa-ports.org/programs/hne/Case%20Studies/2003_Case_Studies/Houston%20%20Might%20Tidy/Houston%20-%20Mighty%20Tidy%20Application.pdf (discussing the Houston Port Authority's use of the boat skimmer "Mighty Tidy," which not only assists the Port in complying with water quality standards, but also has increased public awareness about floating debris and improved the aesthetics of the area).

104 *See* Harris County Flood Control District, Flood Damage Reduction Tools, *supra* note 101.

ating a greater water hazard.[105] However, perhaps of most concern is the possibility of levee failure, which can lead to property destruction and death.[106] In many cases, levees are unsuitable for the needs of urban areas because of the higher level of losses that can result, although they may be entirely suitable for agricultural areas.[107] Therefore, caution should be taken that a community does not place too great a reliance on such a high-risk technology.

Although traditional flood management technology is appropriate in some instances, especially where annual rainfall may be slight, alternative flood management techniques may be appropriate. In areas of greater rainfall, water storage may be a more appropriate option. Prior to the 1980's, for example, channelization was widely used in Houston and Harris County.[108] During the city's development, many bayous were deepened, widened, and straightened.[109] Some portions of the streams were also lined with concrete to improve stream flow.[110] As the Harris County Flood Control District explains, "[b]y 1950, [it] had cleared 5,000 acres of land along streams; channelized 1,260 stream miles; acquired 3,470 right-of-way tracts (75 percent of which were donated); and excavated 25 million cubic yards of earth."[111] Despite these improvements, the downtown area continued to flood, requiring a move to more appropriate types of flood management.

Houston therefore turned to the use of stormwater detention basins and bypass channels in conjunction with channel improvements.[112] Stormwater detention basins are designed to

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105 *Id.*

106 The Association of State Floodplain Managers suggests that levees are "an option of last resort" because they create "situations where the expense of ongoing operation and maintenance costs may, over time, exceed the costs of other mitigation alternatives such as acquisition and relocation or elevation." *See Hurricanes Katrina & Rita: Using Mitigation to Rebuild a Safer Gulf Coast*, (Ass'n of State Floodplain Managers, Madison, Wis.), Sept. 9, 2005, at 4, *available at* http://www.floods.org/PDF/ASFPM_Hurricane Katrina_WhitePaper_090905.pdf [hereinafter ASFP, Using Mitigation]; *see also id.* (stating that "the Corps of Engineers staff has been known to say 'there are only two kinds of levees, those that have failed and those that will fail'").

107 Larson & Plasencia, *supra* note 38, at 168 (noting that levees are suitable for agricultural areas but "fall short of what is needed for high-damage urban settings").

108 Harris County Flood Control District, *Riding the Waves*, *supra* note 101, at 6, 10.

109 For example, a six mile portion of Buffalo Bayou, a major bayou that runs through downtown Houston, was straightened to enhance water flow to the Houston Ship Channel. *Id.*

110 *Id.* Up to 25 miles of concrete lining was added to channels in some areas. *See id.* at 10.

111 *Id.* at 7.

112 *See* Harris County Flood Control District, Stormwater Detention: How it Works, http://www.hcfcd.org/stormwater.asp (last visited Mar. 1, 2006) [hereinafter Harris County Flood Control District, Stormwater Detention].

temporarily store stormwater overflow from a water channel.[113] Such basins can "be several hundred acres in size" and are often used to mitigate the detrimental impacts of new development.[114] During rain events, the detention basin fills. As the water level in the channel drops, the basin empties. Use of the detention basin helps reduce flooding damage by giving the overflow an unpopulated location to sit until rain conditions improve.[115] During non-rain conditions, the basin lies empty and can be used for green space or recreational purposes.[116] Bypass channels are man-made channels intended to divert excess stormwater from its original channel course.[117] Bypass channels are often used in areas where a natural channel might flood an area of great environmental value.[118] In such case, the bypass channel diverts the water, lessening the impact on the area, and reconnects the water to the natural channel further downstream.[119]

Retention basins are another useful management technology. Like detention basins, retention basins are designed for water storage. However, instead of the basin discharging water after or during a storm event, a retention basin holds the water for an indefinite period, often for purposes of aquifer recharge.[120] Communities that have soil conditions favoring such use may find this technology quite advantageous.

Retention and construction of new wetlands can also be used for flood management. Wetlands help to keep water levels in a river or other channel normal by holding water during storm events and slowly releasing them when channel levels are lower.[121] They improve water quality by serving as a filter, purifying the water by allowing the impurities to settle out.[122] The reduction of natural wetlands has led to an increase in flooding

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113 *Id.*

114 *Id.*

115 *Id.*

116 *See id.*

117 Harris County Flood Control District, Flood Damage Reduction Tools, *supra* note 101.

118 *See id.*

119 *See id.*

120 Harris County Flood Control District, Stormwater Detention, *supra* note 112.

121 *See generally* EPA, OFFICE OF WATER, EPA 843-F-04-011A, WETLANDS OVERVIEW 2 (Dec. 2004), *available at* http://www.epa.gov/owow/wetlands/pdf/overview.pdf (explaining that "[w]hen rivers overflow, wetlands help to absorb and slow floodwaters").

122 Jonathan May, *The Current Status of Clean Water Act Jurisdiction and the Future of Non-Tidal Wetlands Protection: A Call to Protect 'Isolated Wetlands,'* 12 U. BALT. J. ENVTL. L. 127, 129 (2005) (stating that "[w]etlands . . . can be viewed as the major determinative factor of the country's water quality, as wetlands not only filter out huge percentages of heavy metals injected into the water, but they can remove almost ninety-five percent of phosphorus, other nutrients, and conventional pollutants from water that eventually leaves [sic] the wetland and seeps into the ground or flows into the nation's vast network of streams, rivers and bays").

problems across the United States.[123] Indeed, the destruction of wetlands along the Louisiana coast has been blamed, at least in part, for the great losses suffered by New Orleans during Hurricane Katrina, because the levees historically provided protection to the city from hurricanes and storm surges.[124]

Artificial wetlands can be constructed to help mitigate the damages created by loss of natural wetlands. Although compensatory mitigation has been required under the Clean Water Act to account for the destruction of natural wetlands due to development,[125] such wetlands have often been small, isolated projects with limited impact on flood management.[126] Mitigation banks, on the other hand, allow developers, utilities, and state and local governments needing mitigation credits to pay a one-time fee to the mitigation bank to satisfy their statutory requirement.[127] Because the mitigation banks are on a large scale, the benefits to flood management and treatment of stormwater runoff are vastly increased.[128]

The move to more natural forms of flood management signals a shift in philosophy regarding the role that stormwater plays in our society. Rather than viewing stormwater as an enemy that must be quickly dispatched or fought, a community can take a more ecologically friendly approach to the problem by utilizing detention and retention basins, bypass channels, and wetlands protection and creation to a greater extent. Such use also offers the benefits for groundwater recharge and recreational opportunities.[129] Indeed, green space and play areas can be created in detention basins or hike and bike trails along channels, which will suffer no harm during storm events.

Regardless of the methods used, however, a community must set aside sufficient funds for upkeep and maintenance of the structural technology. Debris that clutters a storm sewer or channel lessens the utility of the structure and increases the po-

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123 *See* David Ropeik, *Floods Raise Scientific Dilemma,* MSNBC, Apr. 25, 2001, http://msnbc.msn.com/id/3077314/.

124 Dennis Hirsch, Editorial, *Wetlands' Importance Now Made Clear,* ATLANTA J. & CONST., Sept. 12, 2005, at A11.

125 *See* 40 C.F.R. § 230.10(a) (2004); *see also* EPA, EPA 843-F-03-002, WETLANDS COMPENSATORY MITIGATION, *available at* http://www.epa.gov/owow/wetlands/pdf/CMitigation_pr.pdf (last visited Mar. 7, 2006).

126 *See* Jonathan Silverstein, *Taking Wetlands to the Bank: The Role of Wetland Mitigation Banking in a Comprehensive Approach to Wetlands Protection*, 22 B.C. ENVTL. AFF. L. REV. 129, 136 (1994).

127 *See id.* at 134.

128 Harris County Flood Control District, *Green Bayou Wetlands Mitigation Bank,* http://www.hcfcd.org/downloads/brochures/WetlndsMitgatnBankBrochure.pdf 2–3 (last visited Mar. 1, 2006) [hereinafter Harris County Flood Control District, *Green Bayou*].

129 *See id.*

tential of the structure being overwhelmed by the storm event.[130] Therefore, proper maintenance is an essential element of effective flood management.[131]

2. Non-Structural Technology

FEMA's Hazard Mitigation Grant Program[132] provides grants to communities to acquire properties or assist property owners in complying with floodplain ordinances (e.g., elevating homes).[133] Under the program, FEMA can provide up to seventy-five percent of funding for property buyouts, with the remaining twenty-five percent covered by state or local funds.[134] Buyouts are advantageous because it removes an at-risk structure from a flood zone. After the structure is demolished, the community can allow the area to return to its natural condition, thereby lessening the flood risks for others. Even further, for those property owners who remain in the area, aesthetic values (if not economic values) are increased.[135] Because of the great drain that repetitive loss properties place on federal funds, both in terms of disaster relief and insurance payouts, communities should take a more aggressive role in removing repetitive loss properties from the floodplains. In light of the bite that the Insurance Reform Act of 2004 has created,[136] communities should form buyout funds so that money will be set aside to meet the twenty-five percent local requirement and increase their ability to remove structures currently located in the floodplain.

C. Controlled Development

1. Floodplain Ordinances

As discussed above, to participate in the NFIP, communities must promulgate ordinances to reduce future flood risks in spe-

130 *See* OHIO DEP'T. OF NATURAL RES., OHIO STREAM MANAGEMENT GUIDE: STREAM DEBRIS AND OBSTRUCTION REMOVAL, Guide No. 18 (Nov. 1, 2005), *available at* http://www.dnr.ohio.gov/water/pubs/fs_st/stfs18.pdf.

131 PLACER COUNTY, FLOOD CONTROL AND WATER CONSERVATION DISTRICT, STORMWATER MANAGEMENT MANUAL ch. 3 (Sep. 1990), http://www.placer.ca.gov/works/pwswmm/SWMM2004.pdf.

132 The program was initially established by the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C.A. §§ 5121–5206 (West 2003).

133 FEMA, Hazard Mitigation Grant Program, http://www.fema.gov/fima/hmgp/ (last visited Mar. 7, 2006); *see also* FEMA, Hazard Mitigation Grant Program: Elevating Your Home, (last visited Mar. 7, 2006), http://www.fema.gov/fima/hmgp/elevate.shtm.

134 *See* FEMA, FEMA Property Acquisition Projects (Buyouts), http://www.fema.gov/fima/hmgp/buyouts.shtm (last visited Mar. 1. 2006); Press Release, FEMA, 'Buyouts' Possible, But Funding is Limited, (Oct. 15, 1999) http://www.fema.gov/news/newsrelease_print.fema?id=8868.

135 *See id.* (explaining that the buyout advantages include "peace of mind," "fair compensation generally based on the pre-flood market value of your home," and "[a] chance for a new start").

136 *See supra* text accompanying notes 55–58.

cial flood hazard areas.[137] These regulations must be as strict, but may be stricter, than NFIP standards.[138] To encourage communities to exceed these standards, FEMA has established a voluntary incentive program (known as the Community Rating System) that discounts insurance premium rates of communities that reduce flood losses, facilitate accurate insurance ratings, and educate the public about flood insurance.[139] Many communities have instituted more stringent standards than those set out by FEMA.[140] However, in light of the many losses suffered in 2005, it would behoove many states and communities to review their flood management regulations to determine whether higher standards are in order. Such standards might include a complete prohibition on construction or reconstruction in high flood-risk areas and requiring land use compatibility with expected hazards.[141]

Another approach is to adopt the "no adverse impact" standard advocated by the Association of State Floodplain Managers.[142] The idea behind this management approach is that "the action of one property owner does not adversely impact the rights of other property owners, as measured by increased flood peaks, flood stage, flood velocity, and erosion and sedimentation."[143] The advantage of taking the "no adverse impact" standard is that it forces communities to consider their own specific needs and prepare management plans accordingly.[144] This, in turn, gives the community a greater sense of ownership in the management plan since it is not a standardized FEMA ordinance.[145] Further, by creating tailored management plans, the "no adverse impact" standard allows the community to make the changes in other regulations (*e.g.*, zoning) required for enforcement of the plan.[146]

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137 FEMA, THE NATIONAL FLOOD INSURANCE PROGRAM, FLOODPLAIN MANAGEMENT 1 (Nov. 2005), *available at* http://www.fema.gov/pdf/press/katrina_after/floodplain_management_fact_sheet.pdf.

138 *See* 44 C.F.R. § 60.3 (2004).

139 Premium rates can be reduced by up to 45%. FEMA, National Flood Insurance Program - Community Rating System, http://www.fema.gov/nfip/crs.shtm (last visited Mar. 1, 2006).

140 According to FEMA, 1,028 communities currently receive discounted flood rates under the Community Rating System program. *See id.*

141 *See* ASFP, Using Mitigation, *supra* note 106, at 3.

142 *See No Adverse Impact Floodplain Management,* (Ass'n of State Floodplain Managers, Madison, Wis.) (April 29, 2004), *available at* http://www.floods.org/NoAdverseImpact/whitepaper.asp. This policy has already been adopted by some communities, such as Lincoln, Nebraska. *See* CITY OF LINCOLN, WATERSHED MANAGEMENT, DRAINAGE CRITERIA MANUAL: CHAPTER 10: FLOOD DESIGN CRITERIA FOR NEW GROWTH AREAS 10-3 (May 10, 2004), *available at* http://www.ci.lincoln.ne.us/city/pworks/watrshed/flood/standard/.

143 *Id.*

144 *Id.*

145 *Id.*

146 *Id.*

Proper floodplain management also requires enforcement of a community's floodplain ordinance.[147] Violations can lead to a community's probation or even suspension from the NFIP program.[148] Unfortunately, violations are more common than one might think because floodplain administrators are undertrained.[149] For example, common violations noted in Louisiana include**:** (1) lack of a permitting system for special flood hazard areas, (2) failure to certify elevation of the lowest floor above the base flood elevation, and (3) allowing construction below the base flood elevation.[150] Therefore, communities must invest funds for training of floodplain personnel to ensure proper enforcement.

2. Smart Growth Initiatives and Low Impact Development

Effective flood management requires developmental controls both inside and outside a floodplain. Communities can improve flooding conditions by making wiser development choices. One means for communities to achieve these ends is through implementation of **"**smart growth.**"**[151] Smart growth is a variety of initiatives that seek to allow community growth without creating the negative impacts that have traditionally plagued unfettered development.[152] Popularized in the 1990's, smart growth takes many forms, including:

> (1) eliminating state subsidies that promote sprawl; (2) promoting infill development; (3) preserving farmland, open space, and areas of environmental and recreational value; and (4) supporting local planning by providing incentives and technical assistance to local governments and encouraging them to enter into regional planning agreements.[153]

Because smart growth philosophy encourages the retention of farmland and open space, and the preservation of the environment, such initiatives can improve flood conditions by reducing the amount of impervious cover.

Land use and regional planning are also important for effec-

147 *See, e.g.,* LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT, FLOODPLAIN MANAGEMENT REGULATIONS SECTION, FLOODPLAIN MANAGEMENT FACTSHEET 2 (Mar. 2002), *available at* http://www.dotd.state.la.us/intermodal/division/water/documents/fp_2002march.pdf.

148 *Id.*

149 *See, e.g., id.*

150 *See, e.g.*, *id.*

151 *See* Oliver A. Pollard III, *Smart Growth: The Promise, Politics, and Potential Pitfalls of Emerging Growth Management Strategies*, 19 VA. ENVTL. L.J. 247, 249 (2000).

152 *Id.* at 252.

153 Ed Bolen et al., *Smart Growth: A Review of Programs State by State*, 8 HASTINGS NW. J. ENVTL. L. & POL'Y 145, 147 (2002). For a discussion of methods that a community can use to encourage compact development, thereby further reducing impervious cover, *see* Francesca Ortiz, *Biodiversity, the City, and Sprawl*, 82 B.U. L. REV. 145, 177–81 (2002).

tive flood management. Land use planning in the flooding context should take place at a watershed level, involving all communities located within, or that have an impact on, the watershed along with the relevant flood control district. In some cases, this may require greater coordination as some locations contain more watersheds than others. For example, Harris County contains twenty-two watersheds,[154] but there are thirty-five communities and each has its own floodplain administrator.[155] Proper coordination between the communities can lead to improved flood management and more consistency between jurisdictions as it relates to flood ordinances.

Low impact development (LID) is another means to assist in flood management.[156] LID attempts to reduce the impacts of stormwater management, often at a lower cost than traditional means, by using drainage systems that simulate the natural hydrology of an area.[157] The goal of LID "is to reduce runoff volume by infiltrating rainfall water to groundwater, evaporating rain water back to the atmosphere after a storm, and finding beneficial uses for water rather than exporting it as a waste product down storm sewers."[158]

Developers can use simple strategies to help reach this goal.[159] For example, bioretention areas placed in parking lot islands or residential landscaped areas can reduce water volume and filter contaminants from the runoff.[160] Grass swales, a replacement for curbs and gutters, can serve the same purpose.[161]

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154 Harris County Flood Control District, Harris County's Watersheds, http://www.hcfcd.org/watersheds.html (last visited Mar. 1, 2006).

155 *See* Harris County Flood Control District, Contact Information-Floodplain Administrators, http://www.hcfcd.org/contact_floodplain.html (last visited Jan. 9, 2006).

156 EPA, LOW IMPACT DEVELOPMENT, *supra* note 100, at 1.

157 *Id.* at 2, 7; NATURAL RESOURCES DEFENSE COUNCIL, STORMWATER STRATEGIES: COMMUNITY RESPONSES TO RUNOFF POLLUTION, ch. 12 LOW IMPACT DEVELOPMENT (May 1999), *available at* http://www.nrdc.org/water/pollution/storm/chap12.asp [hereinafter NRDC, STORMWATER STRATEGIES]; *see also* Mary Catherine Hager, *Low-Impact Development*, STORMWATER: THE JOURNAL FOR SURFACE WATER QUALITY PROFESSIONALS, Jan.-Feb. 2003, at 18, *available at* http://www.forester.net/sw_0301_low.html ("[R]esults of completed LID projects indicate that the higher initial landscaping costs of LID might be offset by reductions in the infrastructure and site preparation work associated with conventional approaches. Estimates from pilot projects and case studies suggest that LID projects can be completed at a cost reduction of 25–30% over conventional projects—in decreased site development, stormwater fees, and residential site maintenance.").

158 NRDC, STORMWATER STRATEGIES, *supra* note 157 (noting that LID also seeks to "minimize disturbance[,] preserve and recreate natural landscape features[,] reduce effective impervious cover[,] increase hydrologic disconnects[,] increase drainage flow paths[,] enhance off-line storage[, and] facilitate detention and infiltration opportunities").

159 For a more complete discussion of these strategies, *see* Francesca Ortiz, *Smart Growth and Innovative Design: An Analysis of the New Community*, 34 ENVTL. L. REP. NEWS & ANALYSIS 10001, 10019–10023 (2004).

160 EPA, LOW IMPACT DEVELOPMENT, *supra* note 100, at 5–7.

161 EPA, Post-Construction Storm Water Management in New Development & Redevelopment: Eliminating Curbs and Gutters, http://cfpub.epa.gov/npdes/stormwater/

Impervious surfaces can be reduced by the use of roof gardens,[162] permeable pavement,[163] and reduction in street width.[164] Even the use of rain barrels or rainwater tank systems can reduce water volume.[165]

Communities can encourage developers to assist in flood management by creating incentives for LID. Such incentives might include tax breaks or considering LID when calculating a development's drainage impacts and any costs related to those impacts that may be assessed against the developer.

IV. CONCLUSION

Flood management is and always will be an ongoing battle between man and nature because of development choices. Indeed, the initial location of settlements along rivers and coastlines is an indication of the choice to exploit a natural resource at the expense of the damages that it can cause. Increasing development in these areas has only exacerbated problems that already existed as a natural part of the cycle of nature.

To assist communities in flood protection, the federal government has helped fund public works projects that have provided physical protection from flood risks. When physical protection was insufficient, the government turned to increased disaster relief and a federally funded insurance program to provide after-the-fact coverage of the losses incurred. However, local reliance on these programs has reduced the incentive of communities to take responsibility for limiting potential flood losses. As the U.S. House of Representatives Task Force on Disaster reported:

> [i]f state and local governments believe that the Federal Government will meet their needs in every disaster, they have less incentive to spend scarce state and local resources on disaster preparedness, mitigation, response and recovery. This not only raises the cost of disasters to the federal taxpayer, but also to society as a whole, as people are encouraged to take risks they think they will not have to pay for.[166]

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menuofbmps/post_8.cfm (last visited Mar. 7, 2006) [hereinafter EPA, Post-Construction Storm Water Management].

162 Roof gardens not only reduce stormwater runoff, but can also greatly reduce energy costs. EPA, EPA-841-B-00-005D, VEGETATED ROOF COVER 1 (Oct. 2000), *available at* http://lowimpactdevelopment.org/ftp/Roof_cover_Factsheet.pdf.

163 *See* EPA, Post-Construction Storm Water Management, *supra* note 161.

164 EPA, LOW IMPACT DEVELOPMENT, *supra* note 100, at 8; Hager, *supra* note 157, at 12.

165 EPA, LOW IMPACT DEVELOPMENT, *supra* note 100, at 8.

166 HIGHER GROUND, *supra* note 1, at 8 (internal quotation marks and citation omitted).

In light of the increasing populations in coastal areas and a forecast of more severe storm patterns for at least the next decade,[167] the time has come for communities to take greater responsibility for reducing flood risks and preventing flood losses. Reliance on the federal government for after-the-fact relief is merely a crutch, the need for which can be removed by increased involvement in flood management. Active involvement in improving risk assessment, improving and maintaining appropriate flood control technology, and making wiser development choices will open the door to less reliance on federal assistance. Communities must begin making these changes now before the federal well runs dry.

167 *See supra* notes 12 and 13 and accompanying text.